

to aid the self-fertilisation of the flowers the collecting-hairs on the style of Campanulaceæ and Compositæ (see Sprengel, pp. 109 and 370), the pollen-masses of Orchideæ and Asclepiadeæ being fixed near the stigma (Sprengel, pp. 401 and 139), the movements of the stamens of Parnassia, Ruta, and Saxifraga (Sprengel, pp. 166, 236, and 242), as well as the movements of the stigmas of Nigella, Passiflora, and Epilobium (Sprengel, p. 280, 160, and 224). I do not know how to reconcile these errors with Prof. Hagen's statement that Kunth was "beyond doubt acquainted with the facts" discovered by Sprengel. He "beyond doubt" never read Sprengel's book, and I can explain those numerous and crass errors of one of the most celebrated botanists only by the assumption that at that time Sprengel had fallen into almost complete oblivion among German botanists, and remained so till, as Prof. Möbius justly remarks (NATURE, vol. xxix. p. 406), "the value of his treatise in its bearing on the theory of selection was first recognised by Charles Darwin."

FRITZ MÜLLER

Blumenau, Santa Catharina, Brazil, May 25

Voracity of the Drosera

I AM not aware that the *Drosera* has been noticed to capture so large an insect as the dragon-fly, *Pyrrosoma minimum*. Passing a pond-side on a bright June morning, where this insect was flying plentifully, and near which *Drosera rotundifolia* was growing in abundance, I saw that many of these insects had fallen victims to the carnivorous propensities of the plant. On one spot about a foot square I counted six plants which had captured specimens of the dragon-fly, besides smaller insects. One plant had possessed itself of two of the dragon-flies, one being partially digested and the other freshly caught. The *Drosera* plants, being young, were in many instances less in expanse than the dragon-flies caught upon them, which measure about two inches across the wings, with a body about one inch and a half long. The dragon-flies appeared to be attracted to the plants by the reflected sunlight glistening upon the beads of fluid secreted from the leaves, and from which the plant receives its common name of "sun-dew." Those dragon-flies which I saw caught hovered over the plants about a second, at a distance of three or four feet, and then darted upon the plant, when they were instantly caught.

A. BALDING

Wisbech, July 3

Lightning

AT this time of the year one commonly reads of persons being struck dead, blind, or senseless by lightning; some of the phenomena are very puzzling, especially in cases where persons are but slightly injured.

On June 6, 1881, I was in the open country near the sea between Gosport and Southampton, in a place where there was no shelter. Here I was suddenly overtaken by a violent storm of thunder, lightning, and rain. Before I had time to think of escape, the air became darkened by the pouring rain, and, to save myself from a drenching, I perhaps foolishly put up my umbrella; at the same instant I saw a blaze of fire on the right-hand side of my face; the thunder burst at the same moment, and a violent wrenching pain seized the fingers of my right hand (which held the umbrella), the pain instantly travelling to my elbow and shoulder, where it ceased. With the exception of a strong pain in the arm like rheumatism for the rest of the day, I felt no further ill effects.

There is a blind beggar sometimes seen about here who carries a label stating that his eyes were destroyed by lightning; there is no iris to either eye; both are quite white. One day lately I asked him how he lost his sight. He said that he was leaving a country public-house during a thunder-storm, and he received the blow from the lightning at the street-door, as he stood on the top of a short flight of stone steps. He could only remember seeing the blaze of the lightning, and being hurled to the ground down the steps into the street. On his senses returning, he was blind. He states that he had a little glimmering sight at the time of recovery, but first one eye and then the other soon became totally blind.

A few years ago several letters appeared in NATURE regarding the descent of balls of fire in thunder-storms. On July 5, 1881, whilst watching a storm from my windows at 11.30 p.m. I distinctly saw in the south a ball of fire drop from the clouds to the earth. The descent was rapid, but not comparable with

lightning, and with an inclination to the east. The ball appeared large, and about one-half or one-third the apparent size of the moon. A carpenter who was working for me at the time, Mr. George Hebb, on calling upon me a few days after the storm, told me (I had not previously mentioned the matter to him) that he had seen the descent of the same ball of fire from Mildmay Park whilst he was walking towards the south. It is the only example I have seen.

WORTHINGTON G. SMITH

Solar Halo

ON Friday, June 27, about 5 p.m. my attention was drawn to a solar halo which lasted for about two hours from that time; the circular part of the halo was white, and about the size of an ice halo, the sun apparently about four times its proper size and of badly-defined outline; all within the halo was darker than the rest of the sky, and vertically over the sun there was about an octant of another circle (?) touching the first one, but prismatically though not brilliantly coloured. On Saturday night there was a strong pink glow from 9 to 9.30 in the north-north-west, with a greener sky near the moon, which was itself also somewhat green.

W. W. TAYLOR

INSECT PESTS IN THE UNITED STATES¹

THIS volume is issued under the auspices of the Department of Agriculture, and relates entirely to five insect pests. The book is full of matter of general as well as of purely scientific interest, and abounds in suggestions for checking and exterminating the pests of which it treats.

One rises from its perusal with a sense of thankfulness for our temperate climate, insularity, and moderate dimensions. These conditions are unfavourable to excessive multiplication of insect life; and hence we escape the locust, the canker-worm, and the palmer-worm, in their full devastating energy. The connection between solar activity and swarms of insects forms a special section; and the relation between sunspots and locust flights is drawn out in tabular form, showing a striking coincidence between special locust visitations and the minimum of sunspots. This is of course merely a scientific way of showing that hot summers breed insects. The Report deals with the Rocky Mountain Locust, the Western Cricket, the Army-Worm, Canker-Worm, and Hessian Fly, and the treatment of the subject is a full justification of the existence of such a Commission.

An Entomological Section of an Agricultural Department appears to be an absolute necessity in those vast regions, and the facts and phenomena are so startling as to be worthy of constant watchfulness, and this can only be secured by a special and permanent Commission. On the other hand, the powerlessness of man in dealing with the actual invading forces of the winged or creeping armies of Hexapoda is constantly exemplified. It is truly observed that the only effective method of dealing with insects is to study their habits, their structure, their weaknesses, their devolution. It is here that the entomologist shakes hands with the agriculturist. The cultivator is paralysed by the magnitude of the devastation, and the best he can do is to take such self-evident means as are at once available, such as burning, rolling, roping, or the like. The entomologist works less precipitately, but more surely, in studying the sexual and maternal habits of the *imago*, the conditions favourable to incubation, the hatching and development of the *larva*, the transformations to the *pupal* and perfect forms, and lastly, the food and habits of the mature insect.

All these and other matters are searched into by the State entomologist much upon the same principle as a Government section collects information as to the habits and resources of some nation with which it may at some time find itself at war. Thus the Entomological Commission

¹ "Third Report of the United States Entomological Commission. (Washington Government Printing Office, 1883.)

of the United States collects information which may serve a purpose in a war of extermination against the objects of its studies. The volume contains a vast amount of practical information, an extensive series of microscopic sections, chiefly relating to the embryology of insects, zoographical maps of North America, and appendixes bearing upon the subject-matter of the volume. Each destructive insect is very fully treated of with regard to its biological relations, its distribution, ravages, and methods of prevention, all of which are of great interest. A middle section of the volume is occupied with matter which may be described as pure embryology, and deals with the deepest questions which await the microscopist or the biologist. Thus the formation of the blastoderm, endoderm, mesoderm, and inner germinal cells, the phenomena of invagination, the evolution of the brain and ganglionic chain, the philosophy of metamorphosis, and the origin of wings. These matters appear scarcely germane to an Agricultural Department, and it is by no means easy to see how the discussion of such problems can throw the least little ray of light upon economic entomology. Viewed as a pursuit after pure knowledge, and a deep diving after the great mystery of life, these chapters may be considered as a contribution to our speculative knowledge. As a part of an agricultural report they are as relevant as would be a disquisition upon a fourth dimension or molecular movements in solids. At p. 295 is a Genealogy of Insects (Hexapoda), tracing from the Thysanura, followed by a detailed but highly speculative theory of the origin of the Coleoptera and other insect types. "The primitive form of beetle was probably a Staphylinus-like form, with a long narrow body, and rudimentary elytra, and carnivorous in habit." Such speculations probably are useful to their originator chiefly. We do not in fact deny their biological interest, but they are misleading in such a report as that before us. It is no doubt difficult to draw the line between what is useful and what is not, but in loading an economic report with such matter a door is opened which could scarcely be shut against any biological problem whatever. And yet some sop must be thrown to the scientific inquirer enlisted in the service of a Commission. He perchance would mope and pine if too rigidly confined to the economic side without being allowed to express his views upon deeper and wider problems. There is abundance of matter congenial to the agriculturist in these pages. It would not be just in the limits of one short article to attempt to review all the subjects of interest brought within the covers of this volume. We select as an example of the work done by the Commission that familiar enemy of our race, the locust; and we trust room will be found in these columns for a second notice of this work. "If you avoid the destruction of locusts, you will have to forget the welfare of the people: which do you think ought to be thought of first? Was not therefore Tao-choon wise and good when he said 'in killing insects one saves men?'" Good Tao-choon flourished in the reign of Tai-Tzoon (dynasty Tan, from 627 ante till 649 post Christum), and he is still quoted in the Far West as an authority on locust destruction. So far back in point of time and so wide in point of distance do the Commission ransack for information, bringing all to bear upon this war. The Emperor Shen-Tzoon's orders would not perhaps commend themselves entirely to the independent voters of the free States. Thus, "whenever locusts leave desert places to go to populated ones, the local chiefs are obliged to hire poor people and have the eggs destroyed. If all of them should not be destroyed, and the locust therefrom reappear the next year, those commanders will be punished with 100 bamboo-rod blows." Again, "Once the locust appears there is no writing to be done for excuses of absence of chiefs, &c.—paper won't help—the commander-in-chief must be present." Evidently high position in the reign of Shen-Tzoon had its duties and responsibilities as well

as its privileges. The practical and relentless measures recommended are thus described in the same document. "For the purpose of burning the locusts one digs a ditch 5 feet deep and 5 feet wide and twice as long. One empties the bags into the fire. As soon as the locust is in, it won't jump out. That's what the poetry means by 'delivering them over to the flames.' Even in old times they knew that if you bury a locust he will creep out again. Therefore the destruction of locusts by fire, as they did in ancient times, is the best."

The Rocky Mountain locust (*Caloptenus spretus*) is one out of about 200 species of this prolific family represented in North America. If we run our eyes over the map of North America and set aside all that portion contained between meridians 103° and 117° W. of Greenwich, and from the parallels of latitude 40° to 53°, we have the "permanent home" of this insect well before us. It is all considerably elevated, treeless, and arid, thus agreeing to some extent with the locust areas of Eastern Europe, Northern Africa, Asia, Australia, and Central and South America. It includes the greater part of Kansas, Nebraska, Colorado, Wyoming, Utah, Dakota, Montana, Oregon, Nevada, and extends far southward into Mexico. It is bounded on the north by the tree-bearing regions of British America, on the east by the great wheat-bearing regions of the Eastern States, and on the west by the higher ranges of the Rocky Mountains. This gigantic area comprises 300,000 square miles, and the annual rainfall is under twenty inches. It is all elevated, dry, and bracing, and is known physically as the arid region. It is not a wheat-growing area. Here the locust finds a permanent home, free from diseases, and suitable for breeding, and it is from these regions that, about once in eleven years, or at the minimum period of sun-spots, excursions are made and devastation is wrought. Still, while the whole of the permanent region is favourable to the locust, there are in reality but few portions of it that are adapted to its greatest increase. The largest and by far the most important of these specially favourable areas is that of Central Montana and portions of the British Possessions immediately to the north. The next in importance is that of which the Snake River Valley is the centre, while a third locality is that of Southern Utah and parts of adjoining States. We must not pause to consider the prodigious and terrible armies with their devastating effects, "darkening the sun," and "piled up in 'windrows' for miles in length." Such narrations are highly entertaining, but may be "taken as read" by most of the readers of NATURE. With reference to the treatment of this evil, it is hoped that cultivation will restrict the breeding area gradually but surely, and that the changes of climate which follow the husbandman and timber planter may also act advantageously. The active methods consist in digging trenches, sweeping the locusts into them, and burning them. This is best done when the creatures are in a torpid condition at or before sunrise. Harrowing the ground and processes of cultivation are useful in destroying eggs and larvæ. The noise of musketry and artillery prevents swarms from alighting, and is frequently employed for this purpose, as are also fires with damp weeds thrown upon them so as to cause dense clouds of smoke. Marching locusts may be arrested by strips of tin resting against posts or nailed to walls, as they cannot climb over such smooth surfaces. Other methods are referred to as having been published in previous reports of the Commission, but on the whole the means proposed and adopted are of that simple sort which would be suggested rather by common sense than by any profound knowledge of the creatures' habits.

In this respect the Commissioners have been more fortunate in their study of some of the other insect pests. One correspondent writes with regard to locusts:—"They marched uninterruptedly through the village of Colesberg (Cape Colony), over walls and houses, and

destroyed every green thing. The plague lasted for weeks, and until the insects obtained wings, when the winds soon after wafted them away to devastate the lower country, and the ocean received them. Any opposition seemed so hopeless that none was attempted."

Among the most terrible of the insect scourges which affect the vast territories of the Western World, is the army-worm. The name arouses old associations, and one involuntarily recalls "the canker-worm, and the caterpillar, and the palmer-worm, my great army which I send among you." The army-worm well deserves his name, although like most familiar vernacular appellations it may have been wrongly employed. The cotton-worm (*Aletia xylinia*), for example, has been so designated; but the true army-worm is *Leucania unipuncta*, known in the earlier chronicle as the "black worm," and is the larva of a Noctuid moth, named as above by Haworth. It is difficult to give an idea of the fearful character of this plague when in obedience to solar influence it begins its march. "Almost with a shudder (p. 145) one remembers that terrible invasion of Monmouth, when the potato fields were ruined as if by fire, and the waggon wheels reeked with green dripping gore as they entered our villages. . . . That beautiful lawn of Hollywood at Long Branch was invaded by them. The emerald sward was swept as if burnt. When any of the worms came against a tree they went up it, passed over the crotch, then descended at the other side. There is no 'turn back' to this singular worm, and when their path is intercepted by a stream, on they come, until, crowded forward, a compacted mass is urged into the water to serve as a living pontoon, over which the army passes to take possession of pastures new."

Another account states that the army-worm when travelling will scarcely turn aside for anything but water, and even shallow water-courses will not always change its progress. They avoid the rays of the sun, hence during the day they crawl under stones and sticks as closely as they can crowd themselves together, like the cut-worm. They come out towards sunset and continue their mighty march. If they come to a field of grass or young grain they devour the whole of it, down to the very roots; but if it is grown up to stalks they eat the leaves only, and then usually crawl to the top of the stalk and cut off the head and drop it to the ground.

They all keep together like an army of soldiers, and usually advance in a straight line, not swerving from their course to avoid hills, hollows, buildings, or any other obstacle. On coming to a brook, they crowd into it; millions of them are drowned, their dead bodies clogging and damming up the stream in places below, producing by their decay a stench in the atmosphere of the whole vicinity most noisome and intolerable.

Monmouth County was invaded in 1880, and the following graphic sentences from the *New York Sun* will help us to obtain an idea of this calamity:—

"Trenches were seen extending for miles along the roads close to the edges of the fields, but the crops for the most part were withered and lifeless, and it was evident that the precautions had been taken too late. Very often a trench ran across a wheat-field, showing where the farmer had abandoned one portion of his crops and tried to save the remainder. Occasionally a field was seen intersected by numerous trenches, indicating that the proprietor had fought manfully against his persecutors, and disputed the ground with them foot by foot. In many places the road was literally covered with the worms, all in motion, and all moving towards the fields on either side. Thousands and tens of thousands were crushed beneath the waggon wheels and under the horses' feet, but the rest passed on. And at intervals spots were passed where an imaginary line seemed to be drawn across the road beyond which the army-worms could not pass. For a certain space beyond, sometimes for a distance of two or three miles, not only the roads, but the adjoining

country was free from the pest. Not a worm was to be seen until, the clear space passed, the waggon was again rolling over millions of them." The remedies suggested partake of the general character of the means proposed by entomologists, and are probably mostly learnt by the entomologists from the farmers and peasants. They consist in rolling, fencing, ditching, burning, coal-tarring, poisoning, "drawing the rope," which is done by two men drawing the rope in a direction at right angles to its own length.

Another pest of different habits and less widespread destructiveness is the Canker-worm (*Anisophteryx pomonaria* and *escularia*), an insect which feeds on the leaves of apple-trees, and completely ruins orchards. Entomological science has conferred a boon by suggesting methods of getting rid of this creature by taking advantage of its peculiarities. The female, like our glow-worm, is wingless, and therefore cannot rapidly spread beyond the locality where it exists. She hibernates in the earth near the roots of trees, and on the first return of spring she ascends the trunk, depositing her eggs between the leaflets of the expanding buds, sometimes even close to the ground, but oftenest under loose scales of bark. It is this peculiarity of the female which enables the fruit-grower to grapple with the difficulty. One of the best means is what is known as "hanging the band." This contrivance consists essentially of a band or ring of tin a few inches outside the trunk of the tree, and held there by a circle of muslin attached to the tin at its edge, and drawn with a cord at the top, so as to fit the tree closely and prevent the insects from going over the tin, which is coated with a mixture of castor-oil and kerosene: as soon as they touch this they drop to the ground. Troughs of oil arranged closely around the tree, or the complete isolation of the tree by fitted boarding lined on the outside by smooth tin and also fitted with shallow troughs for oil are also used. Another ingenious plan is to use a cylinder of sheet tin upon a band of line or cord. The cord forms a firm boss around the tree, and the hollow cylinder surrounds it and extends them at four inches above and below it. The female finds this an effective barrier, and it is said if she even succeeds in passing upwards to the top of the cylinder she will never descend in the inside so as to again reach the tree.

A good deal of interesting evidence is adduced upon the effects of "jarring and burning," or the jarring of the affected trees, after spreading a light coating of dry straw on the ground below, which is then fired without injury to the trees. A table-spoonful of Paris-green in twelve quarts of water applied to the tree with a large syringe, when, as nearly as can be judged, the worms are all hatched, is a second method. "Fall-ploughing" is a third plan, which appears to have been very successful; and, lastly, attention has been very properly drawn to the balance of power in nature by encouraging birds and parasitic insects that live upon the canker-worm. A valuable distinction has also been pointed out by the Commission between the "fall" canker-worm, and the spring species, from which it differs in many important respects, as may be gathered from its name. There are many other interesting chapters in the volume which we should have liked to at least have mentioned, but it is not our object to do more than give a good general idea as to the work of the Commission and the manner in which it is prosecuted. We therefore leave the consideration of the Hessian fly and the Rocky Mountain cricket, with a hearty recommendation to those who are interested in economic entomology to obtain this Report. J. W.

THE FORESTRY EXHIBITION

IN last week's NATURE (p. 222) we briefly noticed the remarks of the Marquess of Lothian in declaring the International Forestry Exhibition at Edinburgh open. For